

Anritsu

INSTRUCTION MANUAL

OPTICAL HANDY POWER METER

ML96B



ANRITSU CORP.

MP MASTER



MA26051

1986.08 x 300 NV-9(Y)
Printed in Japan

CERTIFICATION

Anritsu Electric Co., Ltd. certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.

Anritsu further certifies that its calibration measurements are based on the Japanese Electrotechnical Laboratory and Radio Research Laboratory standards.

WARRANTY

All Anritsu products are warranted against defects in material and workmanship. The warranty is effective for one year from the date of delivery. In the event of improper use, abuse, or damage due to natural catastrophe, the warranty will become void. Anritsu will repair or replace products which prove to be defective during the warranty period, provided they are returned to Anritsu.

No other warranty is expressed or implied.

All requests for repairs and replacement parts should be directed to Anritsu or its representative in your area.

NOTICE "

Anritsu changed its name from Anritsu Electric Co., Ltd., to ANRITSU CORP.

The new name is effective from October 1st 1985. Please change the old name to the new name in this manual.

N O T E

The battery charger is operable on a nominal voltage from 100 to 127 Vac or from 200 to 254 Vac. The voltage rating is indicated on the label when the battery charger is shipped from the factory. In this manual, a power supply voltage rating is represented by [**] Vac.

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SECTION 1.,

GENERAL

The Optical Handy Power Meter ML96B is used, in conjunction with an Optical Power Sensor MA97B, MA911A, MA912A, MA913A/C, MA98A, MA916A, or MA917A, for the optical power measurement of -60 to +10 dBm in a wavelength range from 0.4 to 1.8 μm .

This instrument, which is handy for the palm, can be used easily in any place. It operates with a internal rechargeable battery continuously about 20 hours.

SECTION 2''

COMPOSITION AND SPECIFICATIONS

2.1 COMPOSITION

The standard composition of the ML96B is shown in Table 2-1.

Table 2-1 Standard Composition

Item	No.	Name	Q'ty	Remarks
Instrument	1	ML96B	1	
Accessories Supplied	2	Sensor connecting cord C	1	2 m long
	3	Battery charger	1	AC**V
	4	Instruction manual	1	

2.2 SPECIFICATIONS

Table 2-2 Specifications

Indicator						
model	ML96B Optical Handy Power Meter					
display	W/dBm/dB (RELATIVE)					
number of figures	4 digit (dBm • dB), 3 1/2 digit (W)					
dimension & weight	85W • 150H • 28D(mm) ≤0.3kg					
accessories	Sensor Connecting Cord C(1), Battery Charger(1)					
Optical sensor						
model	MA911A/ 97B	MA912A	MA916A	MA98A	MA917A	MA913A/ C
wavelength	0.4 to 1.15μm		/	0.8 to 1.8μm		
photo electric conversion device	Si photo diode			Ge photo diode		
active area (diameter)	φ8mm	/	-	/	φ5mm	/ - / -
input type	photo diode		con- nector *1	photo diode	con- nector *1	
indicator connection	connecting cord C		direct- ly con- nected	con- necting cord C	direct- ly con- nected	con- necting cord C
dimension & weight	φ35•27L (mm) ≤0.1kg	φ16.130L (mm) ≤25g	φ27•30L (mm) ≤0.1kg	φ35•27L (mm) ≤0.1kg	φ27•30L (mm) ≤0.1kg	30H, 25W 35D (mm) ≤0.3kg
Overall						
Optical power measuring range	-60 to +10dBm (at 0.85μm)			-40 to +10dBm (at 1.3 μm)	-60 to 0dBm (at 1.3 μm)*2	-50 to 0dBm (at 1.3 μm)
accuracy	±5% (0.85μm, - 10dBm) ±1 digit/±5% (1.3μm, -10dBm) ±1 digit					
resolution	0.1 to 1%(W) 0.01dB (dBm)					
battery life	runs for about 20 hours (on internal NiCd battery)					
ambient temperature, rated range of use	0°C to 45°C					

*1 The standard optical connector is the FC type.
Other types of connector are available.

*2 Directly connected to indicator.

2.3 OPTIONAL ACCESSORIES

Table 2-3 Optional Accessories (sold separately.)

No.	Instrument	Model No.	Remarks
1	Optical Power Sensor	MA97B	0.4 to 1.15 μm Si Sensor
2	Optical Power Sensor	MA911A	0.4 to 1.15 μm Si Sensor
3	Optical Power Sensor	MA912A	0.4 to 1.15 μm Si Sensor
4	Optical Power Sensor	MA916A	0.4 to 1.15 μm Si Sensor (directly connected to indicator.)
5	Optical Power Sensor	MA98A	0.8 to 1.8 μm Ge Sensor
6	Optical Power Sensor	MA913A/C	0.8 to 1.8 μm Ge Sensor
7	Optical Power Sensor	MA917A	0.8 to 1.8 μm Ge Sensor (directly connected to indicator.)
8	Sensor Connecting Cord D		Used when MA916A/MA917A is used separately from ML96B.
9	Optical Fiber Adapter	MP915A	
10	Optical Fiber Adapter	MP93A	
11	Connector Adapter	MP92A	
12	Adapter for MP93A	MP94A	
13	Battery Box		(Six R-6) For operation using dry cells.
14	Carrying Case		Contains ML96B, Sensor (5 types), Adapter (1 set), and battery box.

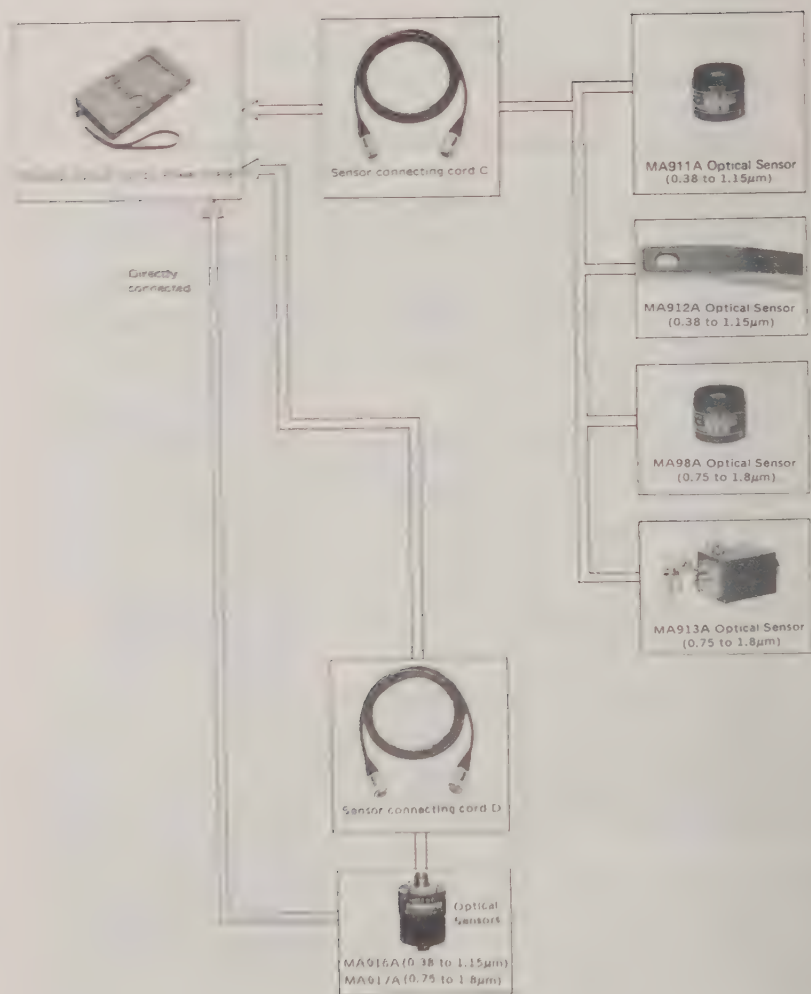
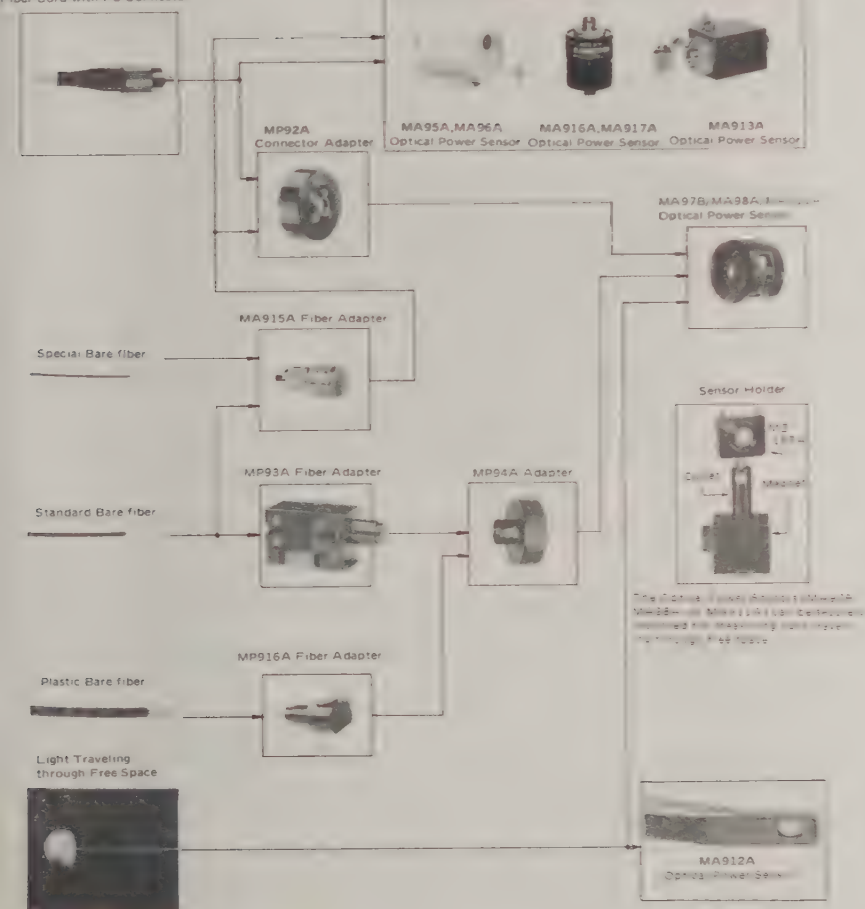


Fig. 2-1 MI96B with Sensors

Fiber Cord with FC Connector



- Standard fiber: Clad diameter of 0.125mm, nylon cover diameter of 0.9mm
 - Special fiber: Clad diameter of 0.125mm, nylon cover diameter of 0.25 to 1mm
 - Plastic fiber: Clad diameter of 1mm
- For other fibers, consult Anritsu.

Fig. 2-2 Sensor Adapters

SECTION 3

OPERATION

3.1 SAFETY MEASURES

3.1.1 Battery

The ML96B normally operates on internal NiCd battery. When the battery is discharged, use the supplied battery charger to charge the battery. If another battery or charger is used, it may damage the internal circuitry. (Refer to 3.3.2)

3.1.2 Environmental Conditions of the Installation Site

ML96B operates normally at an ambient temperature from 0 to 45°C. It should not, however, be used in any of the following locations:

- a. Locations subject to strong vibrations.
- b. Damp or dusty areas.
- c. Locations exposed to direct sunlight.
- d. Locations which might be exposed to active gases.

CAUTION

If the ML96B is used at standard room temperature after having been used or stored at temperatures as low as 0°C for an extended period, condensation may cause it to short circuit. Be sure that the ML96B is free from condensation before turning the power on.

3.1.3 Maximum Input Signal Level

CAUTION

If an external signal of +20 dBm or more is applied to the INPUT and 100 mA or more to the CHARGE terminal of the ML96B it may damage the internal circuitry.

3.2 CONTROLS AND FUNCTIONS

3.2.1 Optical Power Sensor

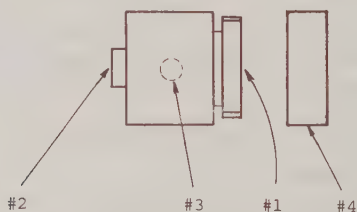


Fig. 3-1 MA97B/911A/916A/98A/913A/C/917A
Optical Power Sensor

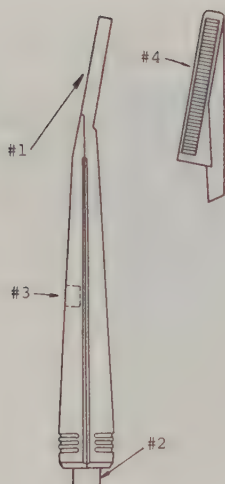


Fig. 3-2 MA912A Optical Power Sensor

Table 3-1 Description of Optical Power Sensor
Operating Controls

No.	Description of function
#1	Light input area: Receives the light to be measured.
#2	Receptacle: Connected to ML96B with the supplied sensor connecting cord.
#3	Sensitivity adjustment variable resistor: Adjusts the photodiode sensitivity in conjunction with ML96B.
#4	Cover: Protects the light input area.

3.2.2 ML96B (Indicator)

Table 3-2 Description on ML96B Operating Controls

No.	Panel Level	Explanation
#1	ON/OFF	Power switch ON/OFF. When the power switch turns on, all the display lights for a second to check the display segment.
#2	CHARGE	When recharging the internal battery, connect the supplied battery charger to this terminal.
#3	INPUT	Connect the sensor connecting cord to this terminal.
#4	ZERO SET	Zero adjusting knob. Temperature delicately affects the reading. Setting the meter at zero prior to measuring ensures accurate reading.
#5	MODE dBm/W	Knob to select dBm or W display. dBm : 4-digit display W : 3 1/2-digit display
#6	MODE dB (REL)	Knob to relative dB display. Indicating relative value to the value when button is pushed, 4-digit display.

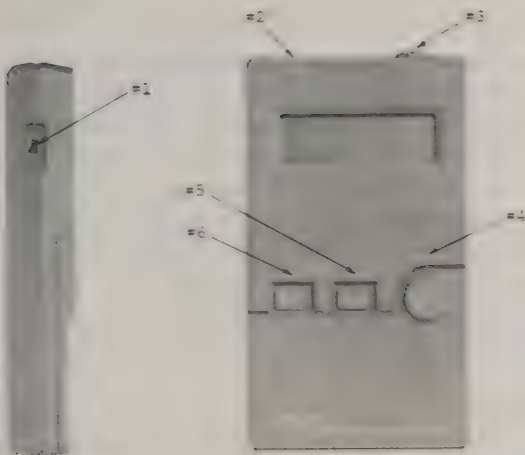


Fig. 3-3 Layout of ML96B Operating Controls

3.3 PREPARATIONS FOR MEASUREMENT

3.3.1 Precautions

If the MA97B, MA911A, or MA98A is used without connector adaptor, or the MA912A is used, the light receiving surface is exposed and measurement errors may be produced due to ingress of leaking surrounding light. Take adequate care against the light ingress.

3.3.2 Internal Battery

The ML96B has a internal NiCd battery which is repeatedly rechargeable. In the fully charged condition, the battery can be used continuously about 20 hours. As the battery is discharged, the display of this instrument will blink or may disappear.

In such a case, use the supplied dedicated-purpose battery charger to charge the battery for about 16 hours.

The battery of this instrument can be used over a very wide temperature range. However, in the discharged condition, use on the extremely low temperature side will be disadvantageous, and any temperature below 0°C should preferably be avoided. Moreover, it will be disadvantageous to carry out charging at high temperatures. A temperature of 45°C to 0°C is advisable. The lifetime of the battery depends on the conditions under which it is used, but under usual service conditions, more than 500 times of recharge can be done.

3.4 MEASUREMENT

The ML96B operates stably 2 to 3 seconds after the power switch has been turned on.

3.4.1 Zero Adjustment

Before starting measurement (or after charging the optical sensor), be sure to make zero adjustment by the following procedure.

- (1) Connect the sensor to the indicator (ML96B) with the cable provided, remove the cover of the sensor, and turn on the power switch of the indicator. The indicator displays a value proportional to the outside optical power strength. If the power switch of the indicator is turned on without connecting the sensor, either of the values shown in Fig. 3-4 is displayed because the input connector is open.

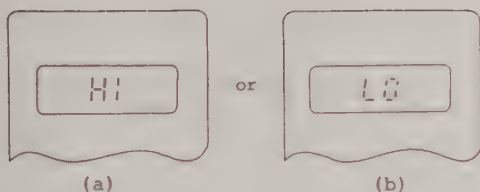


Fig. 3-4 Display Without Connecting the Sensor

- (2) Apply the cover to the light receiving surface of the optical power sensor to shut off the light, then the indicator displays LO shown in Fig. 3-4 (b).
- (3) Set the indicator select switch to W and slowly turn ZERO SET knob so that the indicator displays 0 (0.00 nW in the case of the MA911A/MA912A/MA97B/MA913A/C/MA916A and MA917A or 0.000 μ W in the case of the MA98A).

3.4.2 Measurement of Optical Power

Each optical power sensor has its wavelength responsivity. By reference to the data attached to the optical power sensor, apply spectral sensitivity corrections.

SECTION 4

PRINCIPLES OF OPERATION

Figure 4-1 shows the ML96B block diagram.

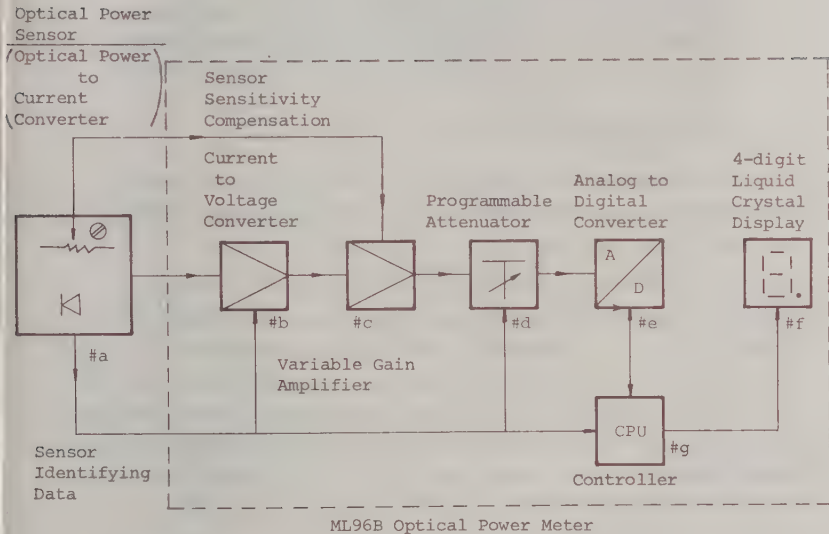


Fig. 4-1 Block Diagram of ML96B

4.1 ML96B (INDICATOR)

Optical Power Sensor #a converts optical power to electric current. In addition, the type data of the Optical Power Sensor #a is sent to CPU #g. Amplifier #b converts the signal current of the sensor to voltage. Besides, the gain of the amplifier #b is switched in steps of 10 dB based on the control signal from CPU #g depending on the measurement level range. To compensate the variation of the sensor sensitivity, the Amplifier #c gain is adjusted. The Amplifier #c output is input to A-D

Converter #e through Attenuator #d. The Attenuator #d attenuation is switched based on the control signal from the CPU #g depending on the measurement level range. The signal is digitalized by A-D Converter #e. The digital data from the A-D Converter #e is logarithm-converted by CPU #g and the logarithm-converted data is displayed on Liquid Crystal Display (LCD) #f.

4.2 OPTICAL POWER SENSOR

The absolute value power of the silicon sensor is calibrated at 0.85 μm and that of the germanium sensor at 1.3 μm .

The optical power sensor #a builds in a variable resistor that compensates the variation of the photodiode responsivity. In addition, the sensor recognition circuit of the ML96B (Indicator) automatically reads the type of the connected Optical Power Sensor and ML96B measures and displays the optical power corresponding to the sensor. Since the photodiode used in this optical power sensor has wavelength characteristic, each sensor is provided with the data on responsivity-wavelength curve.

SECTION 5

ADJUSTMENT

5.1 INTRODUCTION

This section describes the method of storage, adjustment, and daily maintenance of the ML96B. Table 5-1 shows the method of daily maintenance.

Table 5-1 Daily Maintenance

Problem	Occurrence	Procedure
Dirt	° Previous to storing for an extended period of time	Wipe off with industrial cleaning solvent
Dust, etc.	° When used in a dusty environment	Blow out with compressed air, etc.
Lubrication	Unnecessary	
Loosened knob screws	When found	Retighten with a screwdriver, etc.

5.2 STORAGE

5.2.1 Storage Precautions

Attention should be paid to the items listed below when storing the instrument for an extended period of time.

- (1) Always clean the instrument thoroughly before storage.
- (2) Do not store the instrument under high temperatures (55°C or more), high humidity (90% or more), or excessively low temperatures (-10°C or less).

- (3) Do not store the instrument in direct sunlight or in a dusty place.
- (4) Do not store the instrument in a place where it may be affected by condensation or corrosive gases.

5.2.2 Recommended Storage Conditions

In addition to the conditions listed above, the following environmental conditions are recommended when storing the instrument for an extended period of time.

Temperature: 0 to 30°C

Humidity : 40 to 80%

The storage area should not be subject to large fluctuations in temperature and humidity during at 24 hours period.

5.3 ADJUSTMENT

5.3.1 Instruments Required for Adjustment

Table 5-2 Instruments Required for Adjustment

No.	Instrument	Major Specifications	Required for
1	DC voltage standard	Output voltage: 0 to 50 V Resolution : 1 mV	ML96B (Indicator)
2	Oscilloscope	Frequency range : DC to 50 MHz	ML96B (Indicator)
3	Digital Volt Meter	Sensitivity : 1 μ V Input resistance : 10 M Ω	ML96B (Indicator)
4	Light source MG94B: 0.85 μ m MG97B: 1.3 μ m	Output : ≥ -5 dBm Wavelength : 0.85 μ m, 1.3 μ m	Optical power power sensor

Table 5-2 (Cont.)

No.	Instrument	Major Specifications	Required for
5	Optical attenuator MN95A: 0.85 μm MW95B: 1.3 μm	Attenuation : ≥ 50 dB Resolution : 0.01 dB	Optical power power sensor
6	Optical power meter (ML96B)	Measuring range : 0 to -60 dBm Measuring wavelength : 0.85 μm , 1.3 μm	Optical power power sensor

5.3.2 ML96B Sensitivity Adjustment Procedure

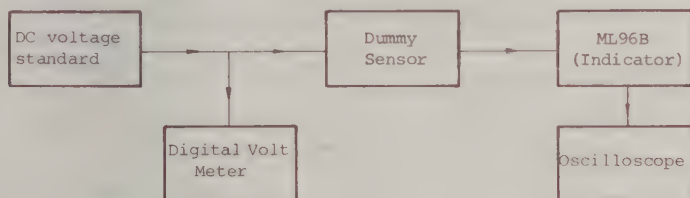


Fig. 5-1 ML96B (Indicator) Sensitivity Adjustment

The dummy sensor shown in Fig. 5-1 is a circuit used to provide an input corresponding to the signal from the optical power sensor to the ML96B. Fig. 5-2 shows the circuit diagram.

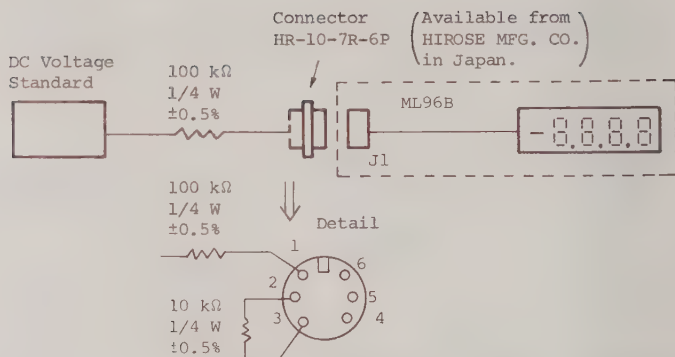


Fig. 5-2 Circuit Diagram of Dummy Sensor

(1) Offset adjustment

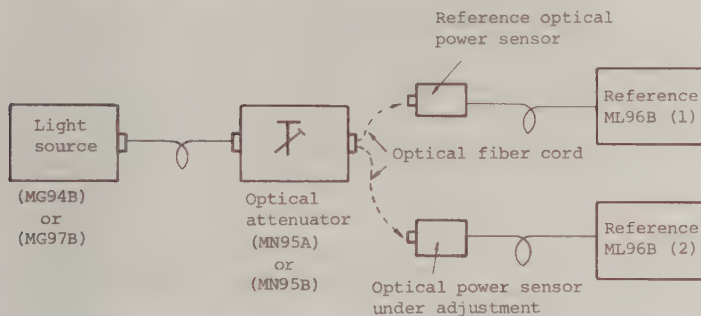
- (a) Set the DC voltage standard output voltage to 0 V.
- (b) Connect the amplifier P.C. board Z1-TP. 4¹/₁ terminal to analog ground. (Refer to Fig. 6-8 Circuit Diagram)
- (c) Adjust Z1-R27 to make the voltage at Q5-6 to 0 V.

(2) Display full scale adjustment

- (a) Set the DC voltage standard output voltage to -5 V.
- (b) Adjust Z1-R24 to make the LCD-display +1.000 mW.

5.3.3 Optical Power Sensor Sensitivity Adjustment Procedure (MA97B/911A/912A/916A or MA98A/913A/C/917A)

- (1) As shown in Fig. 5-3, input an optical power to the reference optical power sensor and adjust the optical attenuator so that the ML96B (1) indicates -10.00 dBm.
- (2) Input the same optical power as in item (1) to the optical power sensor under adjustment and adjust knob #1 shown in Figs. (5-4 and 5-5) to make ML96B (2) indication -10.00 dBm.



NOTE: Assume that ML96B (1) and ML96B (2) are adjusted to the same sensitivity.

Fig. 5-3 Optical Power Sensor Sensitivity Adjustment

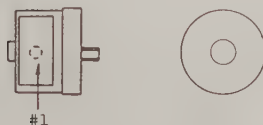


Fig. 5-4 Optical Power Sensor MA97B/911A/916A/
98A/913A/C/917A



Fig. 5-5 Optical Power Sensor MA912A

SECTION 6
TROUBLESHOOTING

6.1 INTRODUCTION

In the event that a trouble occurs in this instrument, find the part in which the trouble exists by the procedure shown in the troubleshooting flowcharts in the following and make repairs.

Find the defective printed circuit board by the procedure of the troubleshooting flowchart shown in Fig. 6-2, and repair it by reference to each printed circuit board's circuit diagram shown in Fig. 6-8, printed circuit board components layout shown in Fig. 6-5 and Fig. 6-7, and test point waveform shown in Fig. 6-4 and Fig. 6-6.

6.2 MECHANICAL CONFIGURATION

Table 6-1 shows the mechanical parts list. Fig. 6-1 shows the exploded diagram of ML96B.

Table 6-1 ML96B Mechanical Parts List

No.	Description	Q'ty
#1	Top Case	1
#2	Bottom Case	1
#3	Strap	1
#4	Knob	1
#5	Z1 Amplifier P.C. Board	1
#6	Z2 Display P.C. Board	1
#7	Z3 Switch P.C. Board	1
#8	Z4 Battery	1
#9	Screw guide & post/spacer	1
#10	Screw	
#11	Screw	2

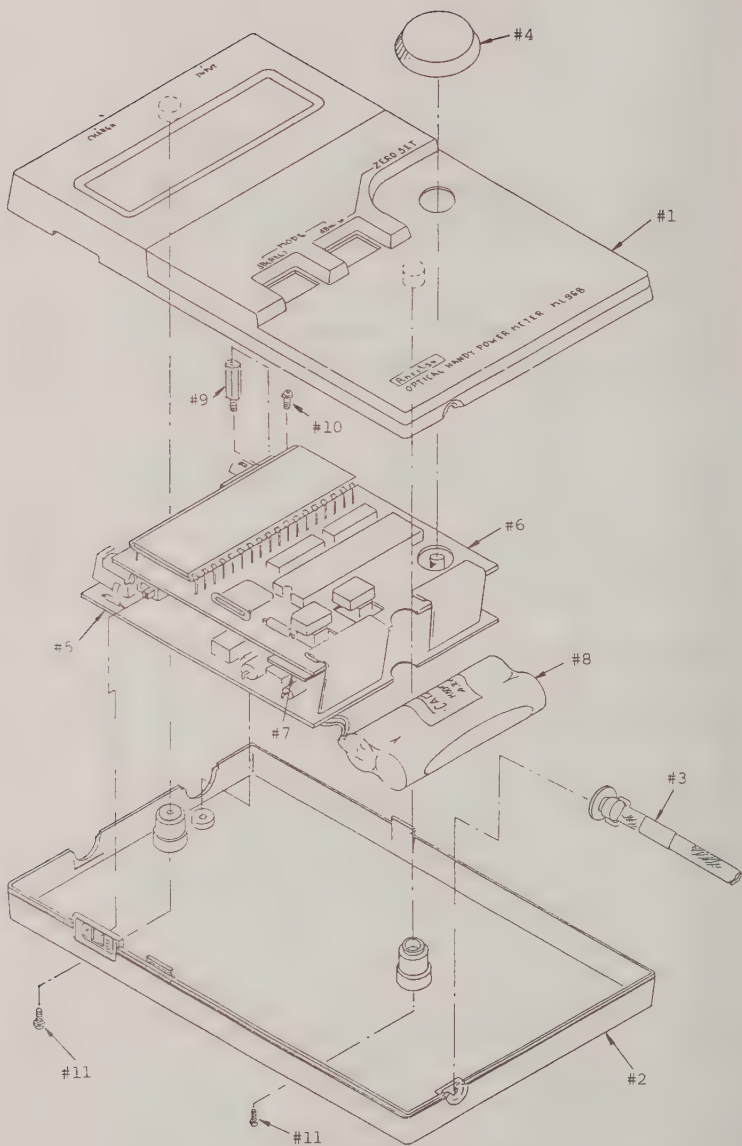


Fig. 6-1 Mechanical Configuration of ML96B

6.3 TROUBLESHOOTING

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This paragraph contains the following contents.

- Fig. 6-2 : Troubleshooting Flowchart to find the defective P.C. Board.
- Fig. 6-3 : Block diagram of ML96B.
- Fig. 6-4 : Amplifier P.C. Board Z1, TP. 1 (Q7-23) Waveform.
- Fig. 6-5 : Component Layout of Amplifier P.C. Board Z1.
- Fig. 6-6 : Display P.C. Board Z2, TP. 1 (Q1-2) Waveform.
- Fig. 6-7 : Component Layout of Display P.C. Board Z2.
- Fig. 6-8 : Circuit Diagram of ML96B (Indicator).
- Fig. 6-9 : Circuit Diagram of MA97B Optical Power Sensor.
- Fig. 6-10 : Circuit Diagram of MA911A/912A Optical Power Sensor.
- Fig. 6-11 : Circuit Diagram of MA916A Optical Power Sensor.
- Fig. 6-12 : Circuit Diagram of MA98A Optical Power Sensor.
- Fig. 6-13 : Circuit Diagram of MA913A/C Optical Power Sensor.
- Fig. 6-14 : Circuit Diagram of MA917A Optical Power Sensor.

For the instruments required, refer to Table 5-2.

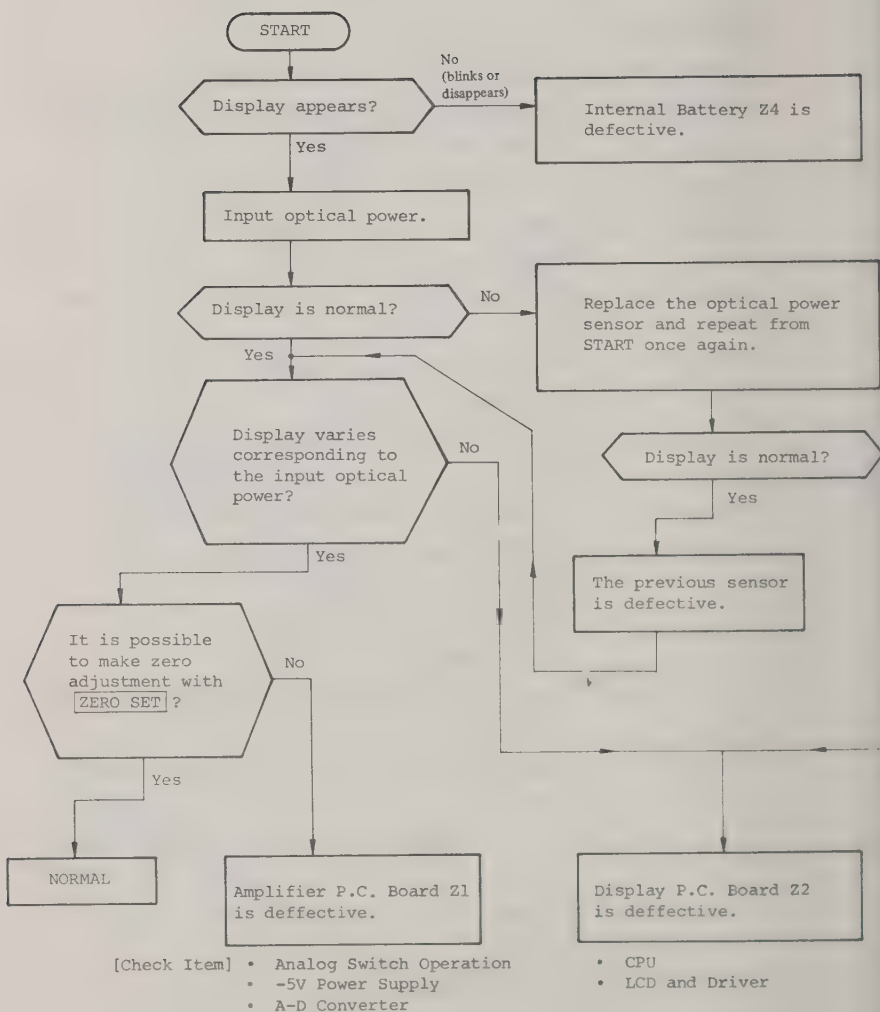


Fig. 6-2 Troubleshooting Flowchart

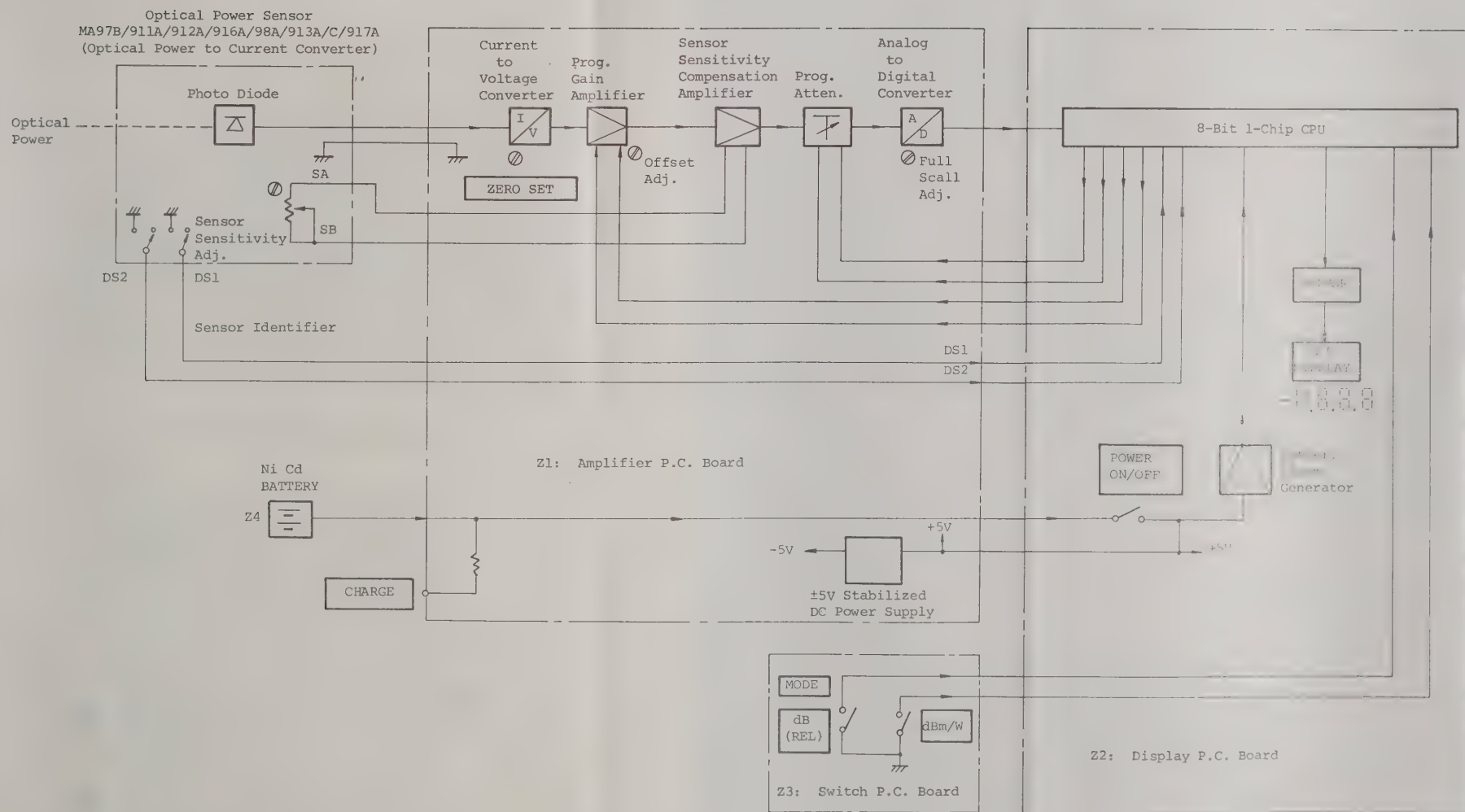
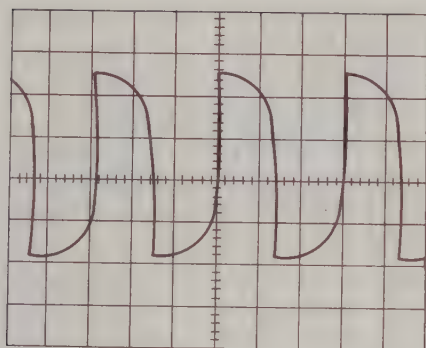


Fig. 6-3 Block Diagram of ML96B Optical Power Meter



V: 1 V/DIV

H: 10 μ S/DIV

Fig. 6-4 Amplifier P.C. Board Z1
TP. ① (Q7-23) Waveform

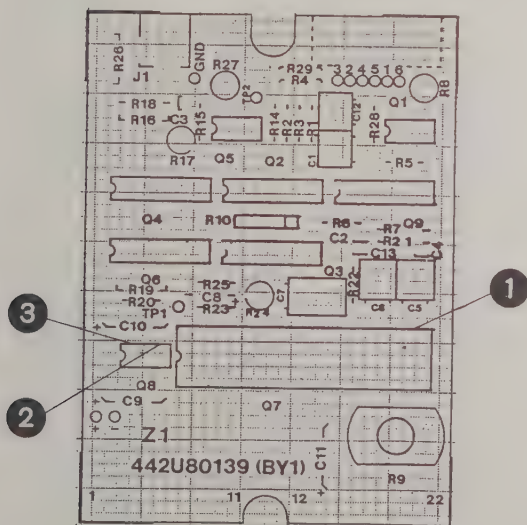
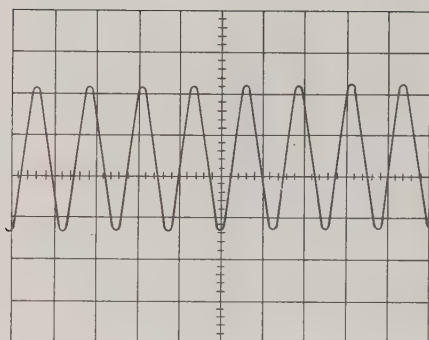


Fig. 6-5 Component Layout of
Amplifier P.C. Board Z1



V: 1 V/DIV

H: 0.2 μS/DIV

Fig. 6-6 Display P.C. Board Z2
TP. ⑤ (Q1-2) Waveform

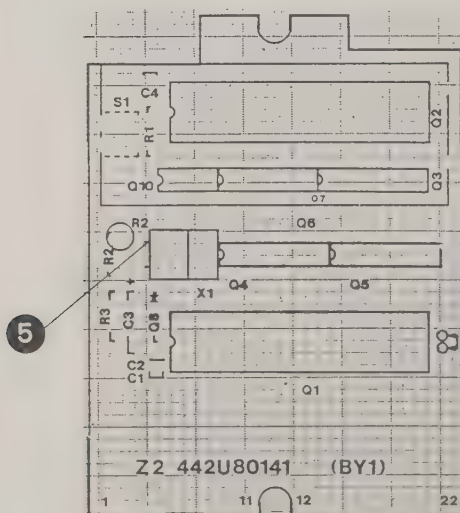


Fig. 6-7 Component Layout of
Amplifier P.C. Board Z2

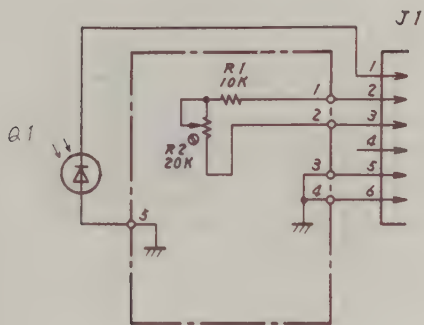


Fig. 6-9 Circuit Diagram of
MA97B Optical Power Sensor

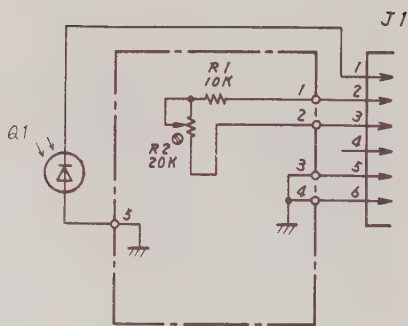


Fig. 6-10 Circuit Diagram of
MA911A/912A Optical Power Sensor

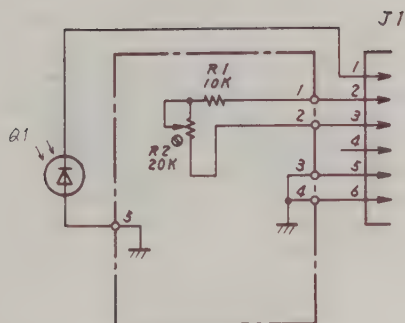


Fig. 6-11 Circuit Diagram of
MA916A Optical Power Sensor

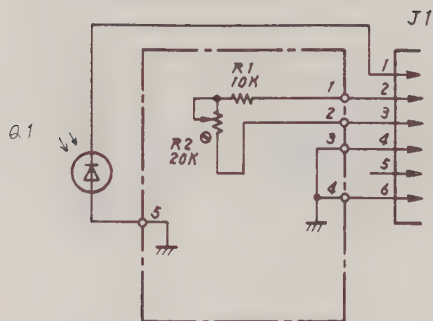


Fig. 6-12 Circuit Diagram of
MA98A Optical Power Sensor

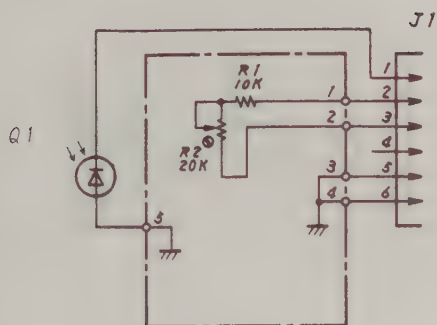


Fig. 6-13 Circuit Diagram of
MA913A/C Optical Power Sensor

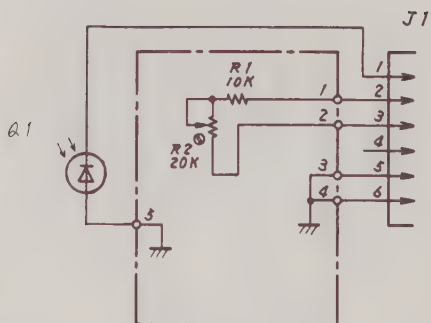


Fig. 6-14 Circuit Diagram of
MA917A Optical Power Sensor

SECTION 7

REPLACEABLE COMPONENTS

7.1 INTRODUCTION

This section contains information relative to ordering replacement components. The following table shows circuit references (CKT REF) and abbreviations used for components given in the component list. In the component list, the quantity of each component is one so far as no quantitative description is given in the "Q'TY" column.

(1) Circuit reference

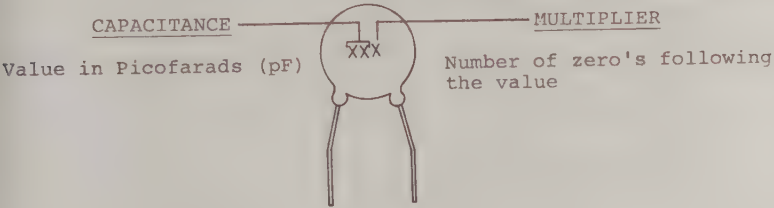
AT : Attenuator	K : Relay	Q : Transistor, Diode, Rectifier, IC	T : Transformer
C : Capacitor	L : Coil	R : Resistor	U : Feedthrough filter
F : Fuse	M : Meter, timer	S : Switch	V : Neon lamp, Vacuumtube
J : Jack, plug, connector	P : Lamp	X : Crystal OSC	Z : Unit

(2) Abbreviations

A	: amperes	J-FET	: junction FET	PNP	: positive-negative- positive
Att. R var	: attenuator variable using film resistive elements	k	: kilo ($\times 10^3$)	p-p,pp	: peak to peak value
BL	: boundary layer	LED	: light emitting diode	RFC	: RF choke
Cer	: ceramic	M	: mega ($\times 10^6$)	R-lamp	: resistor lamp
CF	: carbon film	m	: milli ($\times 10^{-3}$)	rms	: effective value (root means square)
Comp	: composition	MF	: metallized film	SBD	: shottky barrier diode
CRT	: cathode-ray tube	MOS-FET	: metal oxide semi- conductor FET	SCR	: silicon controlled rectifier
Di	: diode	M paper	: metallized paper	Si	: silicon
DIL type	: dual-in line type	M plast	: metallized plastic film	SRD	: step recovery diode
Elect	: electrolyte aluminum	Multi	: multiplying	Tant	: tantalum
F	: farad	N ch	: N channel	Tr	: transistor
FET	: field effect transistor	non-lin	: non-linear taper	Trans	: transformer
G	: ground	Non-pol	: non-polarity	μ	: micro ($\times 10^{-6}$)
Ge	: germanium	NPN	: negative-positive- negative	V	: volt
H	: henry	Ω	: ohms	Var	: variable
Hz	: hertz	p	: pico ($\times 10^{-12}$)	WW	: wire wound
IC	: integrated circuit	Plast	: plastic film	XTAL	: crystal
IEC	: Applicable to IEC Safety Standard	PMTR	: potentiometer		

7.2 METHOD OF READING CAPACITORS/RESISTORS

7.2.1 Capacitor Identification



EXAMPLES: 103 = 10,000pF = 10^{-8} F or 0.01μF
 302 = 3,000pF = 3×10^{-9} F or 0.003μF
 676 = 67,000,000pF = 67×10^{-6} F or 67μF

(a) Ceramic capacitor, polyester capacitor

Indication	0.5	1	10	101	102	103	104
Capacity	0.5pF	1pF	10pF	100pF	1000pF	0.01μF	0.1μF

Example:

Ceramic Capacitor

1000pF

4700pF

0.5pF

10pF

100pF



Capacity values are always underlined.

Polyester Capacitor

1000pF

0.01μF

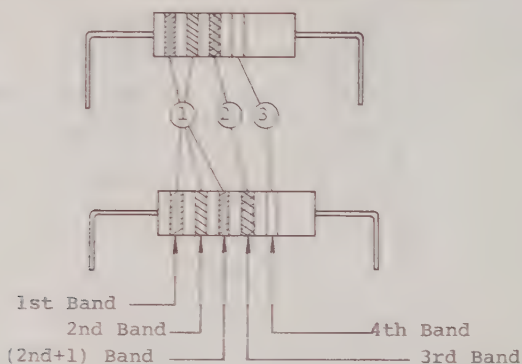
0.1μF



(b) Tantalum capacitor. Metallized capacitor and Electrolytic capacitor

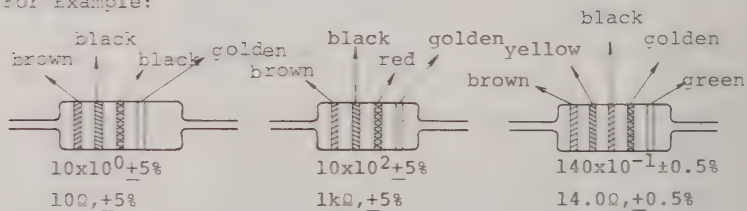
Indication	OR47	010	100	101
Capacity	0.47μF	1μF	10μF	100μF

7.2.2 Resistor Identification



	①		②	③
COLOR	Figure		Multiplier	Tolerance
	1st	2nd	3rd	4th
Black	0	0	$\times 10^0$	-
Brown	1	1	$\times 10^1$	-
Red	2	2	$\times 10^2$	-
Orange	3	3	$\times 10^3$	-
Yellow	4	4	$\times 10^4$	-
Green	5	5	$\times 10^5$	$\pm 0.5\%$
Blue	6	6	$\times 10^6$	-
Purple	7	7	$\times 10^7$	-
Grey	8	8	$\times 10^8$	-
White	9	9	$\times 10^9$	-
Gold	-	-	$\times 10^{-1}$	$\pm 5\%$
Silver	-	-	$\times 10^{-2}$	$\pm 10\%$
-----	-	-		$\pm 20\%$

For Example:



7.3 ORDERING INFORMATION

When ordering components, please give the following information.

Item	Example
a) Name of Instrument	OPTICAL POWER METER ML96B
b) CKT REF	Z1R19
c) Name of component	ARD25T104J
	Note: Name of component is given in parentheses () in the replaceable component list.
d) Quantity	1
e) Serial No. of instrument	No. M31257

7.4 REPLACEABLE COMPONENT LIST

COMPONENT LIST OF OPTICAL HANDY POWER METER ML96B

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10-7R-6S)			
J 2	Connector, (65039-035)	2P		
Z 1	AMPLIFIER P.C. BOARD, (442U80139)			44W74297
Z 2	DISPLAY P.C. BOARD, (442U80141)			44W74298
Z 3	SWITCH P.C. BOARD, (442U80143)			44W74299
Z 4	BATTERY, (4N-250AACADNICA)	4.8V, 25mAH		

(): Manufacturer's part number

* : Selected at factory

44W74296

1/1

COMPONENT LIST OF AMPLIFIER P.C. BOARD Z1 (442U 80139)

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Plast, (MKS-2 0.1 μ F 63V)	0.1 μ F, 63V		
C 2	Cer, (CK924F1H104Z)	0.1 μ F, +80/-20%, 50V		
C 3	Cer, (CK924F1H104Z)	0.1 μ F, +80/-20%, 50V		
C 4	Cer, (RPE111CH151G50)	150pF, $\pm$ 2%, 50V		
C 5	Plast, (MKS-2 0.022 μ F 63V)	0.022 μ F, 63V		
C 6	Plast, (MKS-2 0.15 μ F 63V)	0.15 μ F, 63V		
C 7	Plast, (MKS-2 1.0 μ F 50V)	1.0 μ F, 50V		
C 8	Tant, (CS02H1V010M)	1 μ F, $\pm$ 20%, 35V		
C 9	Tant, (CS02H1D100M)	10 μ F, $\pm$ 20%, 20V		
C10	Elect, (SM6.3T-100(M))	100 μ F, 6.3V		
C11	Elect, (SM6.3T-100(M))	100 μ F, 6.3V		
C12	Plast, (MKS-2 0.1 μ F 63V)	0.1 μ F, 63V		
C13	Cer, (CK924C1H103M)	0.01 μ F, $\pm$ 20%, 50V		
J 1	Jack, (HEC0470-01-230)			
J 2	Connector, (65521-102)			
Q 1	IC, (OP-07DP)			
Q 2	IC, (TC4052BP)			
Q 3	IC, (TC4052BP)			
Q 4	IC, (TC4052BP)			
Q 5	IC, (OP-07DP)			
Q 6	IC, (TC4052BP)			
Q 7	IC, (ICL7109CPL)			
Q 8	IC, (ICL7660CPA)			
Q 9	IC, (TC4052BP)			
Q10	Not assigned			
R 1	MF, (RN14K2E1000D)	100 Ω , $\pm$ 0.5%, 1/4W		
R 2	MF, (RN14K2E1002D)	10k Ω , $\pm$ 0.5%, 1/4W		
R 3	MF, (GS1/4B 1M Ω F)	1M Ω , $\pm$ 1%, 1/4W		
R 4	MF, (GS1/4B 10M Ω F)	10M Ω , $\pm$ 1%, 1/4W		
R 5	MF, (RN14K2E1151D)	1.15k Ω , $\pm$ 0.5%, 1/4W		
R 6	CF, (ARD25T * J)	47k to 220k Ω , $\pm$ 5%, 1/4W		*
R 7	CF, (ARD25T105J)	1M Ω , $\pm$ 5%, 1/4W		
R 8	Var, MF, (RJ-6P 20k Ω)	20k Ω , 1/2W		
R 9	Var, MF, (POT1102P 20k Ω)	20k Ω , 1/2W		

(): Manufacturer's part number

* : Selected at factory

44W74297

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COMPONENT LIST OF AMPLIFIER P.C. BOARD Z1 (442U 80139)

CKT REF	DESCRIPTION	RATING		NOTE
R10	Single in-line array, (IHR-4-103JA)	10k Ω x 4, 1/8W		
R11	Not assigned			
R12	Not assigned			
R13	Not assigned			
R14	CF, (ARD25T102J)	1k Ω , $\pm 5\%$, 1/4W		
R15	MF, (RN14K2E1002D)	10k Ω , $\pm 0.5\%$, 1/4W		
R16	MF, (RN14K2E1002D)	10k Ω , $\pm 0.5\%$, 1/4W		
R17	Var, MF, (RJ-6P 500 Ω)	500 Ω , 1/2W		
R18	MF, (RN14K2E1001D)	1.0k Ω , $\pm 0.5\%$, 1/4W		
R19	CF, (ARD25T104J)	100k Ω , $\pm 5\%$, 1/4W		
R20	CF, (ARD25T103J)	10k Ω , $\pm 5\%$, 1/4W		
R21	CF, (ARD25T104J)	100k Ω , $\pm 5\%$, 1/4W		
R22	CF, (ARD25T683J)	68k Ω , $\pm 5\%$, 1/4W		
R23	MF, (RN14K2E2002D)	20k Ω , $\pm 0.5\%$, 1/4W		
R24	Var, MF, (RJ-6P 100 Ω)	100 Ω , 1/2W		
R25	MF, (RN14K2E7320D)	732 Ω , $\pm 0.5\%$, 1/4W		
R26	MF, (RN14K2E2430D)	243 Ω , $\pm 0.5\%$, 1/4W		
R27	Var, MF, (RJ-6P 20k Ω)	20k Ω , 1/2W		
R28	CF, (ARD25T105J)	1M Ω , $\pm 5\%$, 1/4W		
R29	CF, (ARD25T470J)	47 Ω , $\pm 5\%$, 1/4W		

(): Manufacturer's part number

* : Selected at factory

44W74297

2/2

COMPONENT LIST OF DISPLAY P.C. BOARD Z2 (442U 80141)

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer, (CC924CH1H200J)	20pF, $\pm 5\%$, 50V		
C 2	Cer, (CC924CH1H200J)	20pF, $\pm 5\%$, 50V		
C 3	Tant, (CS02H1V010M)	1 μ F, $\pm 20\%$, 35V		
C 4	Cer, (CC924CH1H040D)	4pF, $\pm 0.5\%$, 50V		
Q 1	IC, (μ PD80C49)			
Q 2	IC, (ICM7211AMIPL)			
Q 3	IC, (TC4054BP)			
Q 4	IC, (TC4054BP)			
Q 5	IC, (TC4054BP)			
Q 6	LCD, (LS069C-C)			
Q 7	IC, (TC400IBP)			
Q 8	Di, (1S953)			
Q 9	Not assigned			
Q10	IC, (MB3761)			
R 1	CF, (ARD25T103J)	10k Ω , $\pm 5\%$, 1/4W		
R 2	MF, (RN14K2E2871D)	2.87k Ω , $\pm 0.5\%$, 1/4W		
R 3	MF, (RN14K2E1001D)	1k Ω , $\pm 0.5\%$, 1/4W		
S 1	Switch, (AS1D-6M)			
X 1	XTAL OSC, (TQC-204B-8C)	4MHz		

(): Manufacturer's part number

* : Selected at factory

44W74298

1/1

COMPONENT LIST OF SWITCH P.C. BOARD Z3 (442U 80143)

CKT REF	DESCRIPTION	RATING		NOTE
S 1	Switch, (KEC10001)			
S 2	Switch, (KEC10001)			

(): Manufacturer's part number

* : Selected at factory

44W74299 1/1

COMPONENT LIST OF OPTICAL SENSOR MA97B

CKT REF	DESCRIPTION	RATING	NOTE
C 1	Connector, (HR10-7R-6P)		
D 1	Diode, photo, (MP-1010)		
R 1	MF, (RN14K2E1002D)	10k Ω , $\pm 0.5\%$, 1/4W	
R 2	Var, MF, (POT1102S-1-203)	20k Ω , 1/2W	

(): Manufacturer's part number

* : Selected at factory

COMPONENT LIST OF OPTICAL SENSOR MA911A/912A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10-7R-6P)			
Q 1	Diode, photo, (MP-1010)			
R 1	MF, (RN14K2E1002D)	10k Ω , $\pm 0.5\%$, 1/4W		
R 2	Var, MF, (POT1102S-1-203)	20k Ω , 1/2W		

(): Manufacturer's part number

* : Selected at factory

W4W5866

1/1

COMPONENT LIST OF OPTICAL SENSOR MA916A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10-7R-6P)			
Q 1	Diode, photo, (S1223-01)			
R 1	MF, (RN14K2E1002D)	10k Ω , $\pm 0.5\%$, 1/4W		
R 2	Var, MF, (POT1102S-1-203)	20k Ω , 1/2W		

(): Manufacturer's part number

* : Selected at factory

W4W5867

1/1

COMPONENT LIST OF OPTICAL SENSOR MA98A

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10-7R-6P)			
Q 1	Diode, photo, (B-1919-01)			
R 1	MF, (RN14K2E1002D)	10k Ω , $\pm 0.5\%$, 1/4W		
R 2	Var, MF, (POT1102S-1-203)	20k Ω , 1/2W		

(): Manufacturer's part number

* : Selected at factory

44W70599

1/1

COMPONENT LIST OF OPTICAL SENSOR MA913A/C

CKT REF	DESCRIPTION	RATING		NOTE
J 1	Connector, (HR10-7R-6P)			
Q 1	Diode, photo, (FPDI3T32WS/001)			
R 1	MF, (RN14K2E1002D)	10k Ω , $\pm 0.5\%$, 1/4W		
R 2	Var, MF, (POT1102S-1- 203)	20k Ω , 1/2W		

(): Manufacturer's part number

* : Selected at factory

W4W5868

1/1

COMPONENT LIST OF OPTICAL SENSOR MA917A

CKT REF	DESCRIPTION	RATING	NOTE
J 1	Connector, (HR10-7R-6P)		
Q 1	Diode, photo, (FPDI3T32WS/001)		
R 1	MF, (RN14K2E1002D)	10k Ω , $\pm 0.5\%$, 1/4W	
R 2	Var, MF, (POT1102S-1-203)	20k Ω , 1/2W	

(): Manufacturer's part number

* : Selected at factory

W4W5869

1/1

MP MASTER



MA26051

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